Selecting a Cost/Benefit Analysis Method

Cost/benefit analyses may be conducted using a simple payback analysis or a more sophisticated analysis of total life cycle costs and savings. Since most electric utility rate schedules are based on both consumption and peak demand, your energy analyst should be skilled at assessing the impacts of both.

Simple Payback Analysis

A highly simplified form of cost/benefit analysis is called “simple payback.” In this method, the total first cost of the improvement is divided by the first-year energy cost savings produced by the improvement. This method yields the number of years required for the improvement to pay for itself.

In simple payback analysis, you are assuming that the service life of the energy efficiency measure will equal or exceed the simple payback time. However, it does not consider a number of factors that are difficult to predict, yet can have a significant impact on cost savings. These factors may be considered by using a more sophisticated life cycle cost (LCC) analysis (described below).

As an example of simple payback, consider the lighting retrofit of a 10,000-square-foot commercial office building. Relamping with T-8 lamps and electronic, high-efficiency ballasts may cost around $13,300 ($50 each for 266 fixtures) and produce annual savings of around $4,800 per year (80,000 kWh at $0.06/kWh). The simple payback time for this improvement would be $13,000/$4,800 annually = 2.8 years. That is, the improvement would pay for itself in 2.8 years, a 36% simple return on the investment (1/2.8 = 0.36).

Standardized Payback Equations

Schools can take advantage of a building energy measurement and verification guideline that standardizes procedures for quantifying energy savings from energy-efficiency projects. Called the International Performance Measure Measurement and Verification Protocol (http://www.ipmvp.org/), this guideline reduces risk and standardizes paperwork. It also enable loans to be bundled together and sold on a secondary market, like mortgages. For more information on measurement and verification, refer to the U.S. Department of Energy's Rebuild America Financial Services (http://www.ornl.gov/rafs/rafs.htm) site.

Life Cycle Cost Analysis

Life cycle costing is an analysis of the total cost of a system, device, building, or other capital equipment or facility over its anticipated useful life. LCC analyses allow a comprehensive assessment of anticipated costs associated with a design alternative. Factors commonly considered in LCC analyses are initial capital cost, operating costs, maintenance costs, financing costs, the expected useful life of equipment, and future equipment salvage values. The result of the LCC analysis is generally expressed as the value of initial and future costs in today's dollars as reflected by an appropriate discount rate.

The first step in performing an LCC analysis is to establish the general study parameters for the project, including the base date (the date to which all future costs are discounted), the service date (the date when the new system will be put into service), the study period (the life of the project or the number of years over which the investor has a financial interest in the project), and the discount rate. When two or more design alternatives are compared or when a single alternative is compared against an existing design, the variables compared must be the same to ensure that the comparison is valid. It is meaningless to compare the LCC of two or more alternatives if they are computed using different study periods or different discount rates.

Decision makers in both the public and private sectors have long used life cycle costing to obtain an objective assessment of the total cost of owning, operating, and maintaining a building, a building system, and/or improvement for its useful life. Nevertheless, an LCC analysis does require the use of sound judgment of acceptable alternatives, useful life, equipment efficiencies, and discount rates.

Selecting the "Best" Alternatives

Generally, all project alternatives should be initially screened using simple payback analyses. A more detailed and costly LCC analysis should be reserved for large projects or those improvements that entail a large investment, since a detailed cost analysis would then be a small part of the overall cost. Both simple payback and LCC analyses will allow you to set priorities based on measures that represent the greatest return on investment. In addition, these analyses provide a preliminary indication of appropriate financing options:

- Energy efficiency measures that have a short payback period of 1 to 2 years are the most attractive economically and should be considered for implementation using operating reserves or other readily available internal funds.
- Energy efficiency measures that have payback periods from 3 to 5 years may be considered for funding from available internal capital investment monies, or may be attractive candidates for third-party financing through energy service companies or equipment leasing arrangements.
- Frequently, short payback measures can be combined with longer payback measures of 10 or more years to increase the number of measures that can be cost-effectively included in a project. Projects that combine short- and long-term paybacks are recommended to avoid "cream-skimming" (implementing only those measures that are highly cost-effective and have quick paybacks) at the expense of other worthwhile measures. A selected set of measures with a combination of payback periods can be financed either from available internal funds or through third-party alternatives.

If simple payback time is 10 or more years, economic factors are very significant and LCC analysis is recommended. In contrast, if simple payback occurs within 3 to 5 years, more detailed LCC analysis may not be necessary, particularly if price and inflation changes are assumed to be moderate. Under this assumption, a simple payback analysis will often be within 15% to 20% of the payback time estimated from a detailed LCC analysis. In general, detailed life cycle cost analyses may not be justified if the payback of the improvement is less than five years.

In any cost analysis, it is very important to include avoided cost as part of the benefit of the retrofit. When upgrading or replacing building equipment, the avoided cost of maintaining existing equipment should be considered a cost savings provided by the improvement. The purpose of performing cost/benefit analyses at this point is primarily to narrow the selection of potential measures. Further economic evaluation of individual measures should be conducted during the detailed planning for implementation.

Weighing Societal Impacts

Some factors related to building heating, air conditioning, and lighting system design are not considered in either simple payback or LCC analyses. Examples include the thermal comfort of occupants in a building and the adequacy of task lighting, both of which affect productivity. A small loss in productivity due to reduced comfort or poor lighting can quickly offset any energy cost savings.

Conventional cost/benefit analyses also normally do not consider the ancillary societal benefits that result from reduced energy use (e.g., reduced carbon emissions, improved indoor air quality). In some cases, these ancillary benefits are assigned an agreed upon monetary value, but the values to be used are strongly dependent on local factors. In general, if societal benefits have been assigned appropriate monetary values by a local utility, they are considered in savings calculations. However, your team should discuss this issue with your local utility or consultants working on such values in your area.